

9-28 SIGNING MATERIALS AND FABRICATION**9-28.1 General**

Unless noted otherwise in the Plans, permanent signs shall be constructed of sheet aluminum. Permanent signs which measure 36-inches or less on a side and are to be mounted on a single post may be constructed of single 0.135-inch fiberglass reinforced plastic panels. Sign overlay panels may be either 0.050-inch aluminum or 0.075-inch fiberglass reinforced plastic panels. All signs, except internally illuminated signs, shall be reflectorized.

See ASTM D 4956 for reflective sheeting type designations. Standard control signs and guide sign borders, letters, numerals, symbols, shields, and arrows shall be in accordance with the "Washington State Sign Fabrication Manual."

All STOP, YIELD, DO NOT ENTER, WRONG WAY, FREEWAY ENTRANCE, and HIGHWAY ENTRANCE signs shall be constructed entirely of Type III or IV reflective sheeting. All M series, I series, and D-10 series signs and all signs with blue or brown backgrounds shall be constructed entirely of Type II reflective sheeting unless otherwise specified. Background reflective sheeting for all other signs shall be as noted in the Plans. Sign legends for all other signs shall be constructed of Type III or IV reflective sheeting. Sign legends include: borders, letters, numerals, symbols, shields, and arrows. Reflective legend sheeting types shall not be mixed on individual signs.

9-28.1(1) Basis for Acceptance

Reflective sheeting shall be accepted on the basis of inclusion of the material/product on the Qualified Product List or by approval of a Request for Approval of Materials. The sign fabricator shall have available for inspection a copy of the Manufacturer's Certificate of Compliance for each lot of reflective sheeting. This certificate shall verify that the reflective sheeting meets all the requirements of Section 9-28.12.

The basis for acceptance of aluminum sign blanks and panels shall be a mill test certificate from the aluminum manufacturer attesting to the correct alloy and temper of the metal supplied. At the option of the Engineer, laboratory tests may also be performed to confirm metallurgical data.

It is expressly understood that the furnishing of certificates of compliance will not relieve the Contractor from the obligation to replace materials found defective after delivery to the project, nor will they prevent the Engineer from sampling material when it arrives on the project and subjecting it to such laboratory tests as they may deem appropriate or significant.

9-28.1(2) Inspection

All signs will be inspected at the fabricator's plant before shipment to the project. The inspection shall not be made until all materials have been tested and approved. Signs without a "FABRICATION APPROVED" decal will not be installed on the project with the exception of double-faced signs which do not receive decals or fabricator's stickers.

9-28.2 Manufacturer's Identification and Date

All signs shall show the manufacturer's name and date of manufacture on the back. In addition, the width and height dimension, in inches, and the number of the sign as it appears in the Plans shall be placed using 3-inch series C black letters on the back of destination, distance, and large special signs. Hand painted numbers are not permitted.

9-28.3 Corner Radius

All regulatory and warning signs shall have rounded corners with the exception of stop signs. Information and guide signs may have square cut corners. Borders for signs having square cut corners shall have a corner radius approximately $\frac{1}{8}$ of the lesser side dimension of the sign up to a maximum radius of 12-inches. For signs with rounded corners, the borders shall be concentric with the rounded corners.

9-28.4 Extruded Windbeams and "Z" Bar

All multiple post and multiple panel signs shall be constructed and installed with horizontal extruded windbeams and "Z" bar, when required, as shown in the Plans or the Standard Plan. All bolt and rivet heads visible on the sign face shall be anodized or painted to match the sign area immediately surrounding the bolt or rivet head. Extruded windbeams and "Z" bar shall be accepted on the basis of a certificate of compliance from the manufacturer. Materials shall be as designated in Section 9-28.11.

9-28.5 Letter and Spacing Formula

Letter and arrow sizes shall be as specified in the Plans. Spacing formulas shall be those furnished by the manufacturer of the letters.

9-28.6 Destination Sign Messages

Destination sign messages, borders, shields, and symbols shall be direct applied unless otherwise noted in the sign plans. All message components shall be one piece construction unless the least dimension exceeds available sheeting widths. All components shall have smooth, sharp cut edges. Components which are torn, wrinkled, or exhibit poor workmanship, will not be permitted.

9-28.7 Process Colors

Transparent and opaque process colors used in silk screening sign messages shall be as recommended by the manufacturer. When properly applied, process colors shall perform satisfactorily for the expected life of the sheeting. Applied colors shall present a smooth surface, free from foreign material, and all messages and borders shall be clear and sharp. Sheeting shall conform to the retroreflective minimum values and color limits established for its type and color without regard to whether the color is integral to the sheeting or achieved by applying transparent colors to silver/white sheeting. There shall be no variations in color, and overlapping of colors will not be permitted.

Properly applied and cured process colors shall exhibit no blistering, bubbling, or loss of color or transparency when cleaned with a mild non-abrasive detergent solution. Minor loss of color may be detected when solvents such as kerosene, mineral spirits, heptane, or VM&P Naphtha are used to clean severely contaminated signs; e.g., paint vandalism. However, the colors shall not blister, bubble, peel, or be easily removed.

9-28.8 Sheet Aluminum Signs

Sheet aluminum signs shall be constructed of material conforming to ASTM B 209 alloy 6061-T6 or alloy 5052-H36 or H38. Alloy 5005-H34 may be used for sign overlays.

After the sheeting has been fabricated, the sheeting for all multiple panel signs shall be degreased, etched by immersion for a minimum of 5 minutes in a 6-ounce per gallon caustic etch solution at 120°F, followed, in order, by a water rinse, de-oxidation, water rinse, hot water rinse, and drying. The etching process shall produce a dull aluminum finish on both sides of the panel which will last the life of the sign. The treated panel surface shall be compatible with the opaque and reflective sheeting to be applied in accordance with the Specifications. The Contractor may use an Alodine 1200 application for single panel signs in lieu of the above treatment. Aluminum signs over 12-feet wide by 5-feet high shall be comprised of vertical panels in increments of 2, 3, or 4-feet wide. No more than one 2-foot and/or 3-foot panel may be used per sign. The Contractor shall use the widest panels possible. All parts necessary for assembly shall be constructed of aluminum, galvanized, or stainless steel in accordance with the plans. Sheet thickness shall be as follows:

Maximum Horizontal Dimension	Sheet Aluminum Thickness
Overlay panels	0.050-inch
Up to 20-inches	0.063-inch
20-inches to 36-inches, inclusive	0.080-inch
Over 36-inches (Permanent Signs)	0.125-inch

The side dimension for a diamond shaped warning sign is considered to be the maximum horizontal dimension.

Before placing aluminum in contact with untreated steel, the steel surfaces shall be protected by proper cleaning and painting with one coat of Zinc Primer A-9-73 or A-11-99 and two coats of aluminum paint D-1-57.

Metal shall be handled by device or clean canvas gloves between all cleaning and etching operations and the application of reflective sheeting.

9-28.9 Fiberglass Reinforced Plastic Signs

Fiberglass reinforced plastic signs and overlay panels shall be constructed of a fiberglass reinforced thermoset polyester laminate. The sign panel shall be acrylic modified and UV stabilized for outdoor weathering ability.

The sign panel shall be stabilized to prevent the release of migrating constituents (such as solvents, monomers, etc.) over the expected life of the sign. The sign panel shall contain no residue release agents on the surface of the laminate so neither migrating constituents or release agents will be present in amounts which will interfere with any subsequent bonding operations.

The sign panel shall not contain visible cracks, pinholes, foreign inclusions, or surface wrinkles that would affect implied performance, alter the specific dimensions of the panel, or otherwise affect its serviceability.

The sign panel surface shall be wiped clean with a slightly water dampened cloth before applying reflective sheeting.

9-28.9(1) Mechanical Properties

All mechanical properties are stated as minimum requirements. The mechanical properties are measured in both the line direction of the panel and at 90 degrees to the line as noted in the appropriate ASTM test referenced.

Mechanical Property	Ave. Min. Requirement	ASTM Test
Tensile Strength	10.0 psi × 103	D638
Tensile Modulus	1.2 psi × 106	D638
Flexural Strength	20.0 psi × 103	D790
Flexural Modulus	1.2 psi × 106	D790
Compression Strength	32.0 psi × 103	D695
Compression Modulus	1.4 psi × 106	D695
Punch Shear	13.0 psi × 103	D732

9-28.9(2) Physical Properties

Sign Panels are to be 0.135-inch thick. Overlay panels are to be 0.075-inch thick. Panel thickness tolerance shall be plus or minus 0.005-inch. Panel tolerance on nominal length and width shall be plus or minus 1/8-inch for dimensions of 12-feet or less and shall be within 1/8-inch of square per 12-feet of length when measured in accordance with ASTM D 3841.

Panels shall be manufactured with smooth surfaces on both top and bottom of the panel.

Panel flatness of a 30-inch by 30-inch panel shall be measured by hanging the panel diagonally in suspension. The maximum deflection measured diagonally, parallel and perpendicular to the panel by lines drawn through the center of the panel, shall not exceed 1/2-inch. The panel shall then be hung diagonally in suspension in an oven for 48 hours at 180°F. The maximum deflection shall again be measured as previously noted and shall not exceed 1/2-inch. All measurements shall be made when panels are at ambient temperature.

Panels shall be pigmented to a visually uniform gray color within the MunsellR range of N.7.5/ to N.8.5/.

Panels shall have a maximum coefficient of lineal thermal expansion of 1.8×10^{-5} in/in/°F. when tested in accordance with ASTM D696.

Panels shall be classified as to a minimum Grade II (weather resistant) panel as specified in ASTM D 3841 following 3,000 plus or minus 100 hour weatherometer test.

Panels shall contain additives designed to be less responsive to fire ignition and flame propagation. As such, the extent of burning shall not exceed 1.0-inch when tested in accordance with ASTM D 635.

Panels shall resist the impact energy of 20 foot-pounds applied with a hemispherical tipped object 1-inch in diameter.

The panels thermal stability for strength and impact resistance qualities shall not be appreciably affected over a temperature range of -65°F to 212°F.

Fiberglass reinforced plastic panels for signs shall be accepted on the basis of a certificate of compliance from the manufacturer as outlined in Section 1-06.3.

9-28.10 Vacant

9-28.11 Hardware

Bolts, nuts, locknuts, and washers shall be of the same material for each attachment. Bolts, nuts, locknuts, and washers for signs mounted on overhead sign structures (i.e. sign bridges, cantilevers sign structures, and bridge mounted sign brackets) shall be stainless steel only.

Hardware	Specification
Bolts	ASTM F 468 2024-T4 Aluminum ASTM A 307 Steel ASTM F 593 Group 1, Condition A Stainless Steel, or ASTM A 193, Grade B8, Class 1 Stainless Steel
U-bolts	ASTM A 276 Type 304 Stainless Steel
Washers	ASTM B 209 2024-T4 Aluminum ASTM F 844 Steel ANSI B.18.22.1 Stainless Steel Alloy 304
Nuts	ASTM F 467 2024-T4 Aluminum ASTM A 563 Grade A Steel ASTM F 594 Group 1 Stainless Steel, or ASTM A 194 Grade 8 or 8A Stainless Steel
Locknuts (with nylon insert unless otherwise in the Plans)	ASTM F 467 2024-T4 Aluminum ASTM A 563 Grade A Steel ASTM F 594 Group 1 Stainless Steel, or noted ASTM A 194 Grade 8 or 8A Stainless Steel
Rivets	ASTM B 316 5052 Aluminum Alloy ASTM B 316 5056 Aluminum Alloy
Post Clips	ASTM B 179 356-T6 Aluminum
Windbeams	ASTM B 221 6061-T6 Aluminum
Angle and "Z" Bar	ASTM B 221 6061-T6 Aluminum ASTM A 36 or ASTM A 992 Steel
Strap and Mounting Bracket	ASTM A 666, Type 201 Stainless Steel

All steel parts shall be galvanized per AASHTO M 111. Steel bolts and related connecting hardware shall be galvanized per AASHTO M 232.

9-28.12 Reflective Sheeting

Type I and Type II reflective sheeting shall consist of spherical lens elements embedded within a transparent plastic having a smooth, flat outer surface. Type III and Type IV reflective sheeting shall consist of spherical or prismatic lens elements adhered to a synthetic resin and encapsulated by a flexible, transparent, weatherproof plastic having a smooth outer surface. Type V reflective sheeting shall consist of metallized microprismatic lens bonded to a flexible, smooth-surfaced, weather resistant polymeric film. Type VI reflective sheeting shall consist of unmetallized microprismatic lens formed on a flexible vinyl material. Type VII, VIII, IX and Type X Fluorescent Orange reflective sheeting shall consist of unmetallized microprismatic lens formed in a synthetic resin and encapsulated by a flexible, transparent, weatherproof plastic having a smooth outer surface. All sheeting shall be weather resistant and have a protected pre-coated adhesive backing. Type II reflective sheeting shall contain an identifying marking, such as a water mark, which is visible after sheeting application. The marking shall not adversely affect the performance or life of the sheeting.

The reflective sheeting shall have the following minimum coefficient of retroreflection values at 0.2 degrees and 0.5 degrees observation angle expressed as average candelas per foot-candle, per square foot of material. Measurements shall be conducted in accordance with ASTM E 810.

Type I Glass Bead Retroreflective Element Material

Obs. Angle	Entrance Angle	SILVER WHITE	YELLOW	ORANGE	GREEN	RED	BLUE	BROWN
0.2°	-4°	70	50	25	9.0	14	4.0	1.0
0.2°	+30°	30	22	7.0	3.5	6.0	1.7	0.3
0.5°	-4°	30	25	13	4.5	7.5	2.0	0.3
0.5°	+30°	15	15	4.0	2.2	3.0	0.8	0.2

Type II Glass Bead Retroreflective Element Material

Obs. Angle	Entrance Angle	WHITE	YELLOW	ORANGE	GREEN	RED	BLUE	BROWN
0.2°	-4°	140	100	60	30	30	10	5.0
0.2°	+30°	60	36	22	10	12	4.0	2.0
0.5°	-4°	50	33	20	9.0	10	3.0	2.0
0.5°	+30°	28	20	12	6.0	6.0	2.0	1.0

Type III Glass Bead Retroreflective Element Material

Obs. Angle	Entrance Angle	SILVER WHITE	YELLOW	ORANGE	GREEN	RED	BLUE	BROWN
0.2°	-4°	250	170	100	45	45	20	12
0.2°	+30°	150	100	60	25	25	11	8.5
0.5°	-4°	95	62	30	15	15	7.5	5.0
0.5°	+30°	65	45	25	10	10	5.0	3.5

Type IV Micro Prismatic Retroreflective Element Material

Obs. Angle	Entrance Angle	WHITE	YELLOW	GREEN	RED	BLUE	BROWN
0.2°	-4°	250	170	35	35	20	7.0
0.2°	+30°	80	54	9	9	5.0	2.0
0.5°	-4°	135	100	17	17	10	4.0
0.5°	+30°	55	37	6.5	6.5	3.5	1.4

Type V Metallized Micro Prismatic Retroreflective Element Material

Obs. Angle	Entrance Angle	WHITE	YELLOW	ORANGE	GREEN	RED	BLUE
0.2°	-0.4°	700	470	280	120	120	56
0.2°	+30°	400	270	160	72	72	32
0.5°	-0.4°	160	110	64	28	28	13
0.5°	+30°	75	51	30	13	13	6.0

Type VI Vinyl Micro Prismatic Retroreflective Element Material

Obs. Angle	Entrance Angle	WHITE	YELLOW	ORANGE	GREEN	RED	BLUE
0.2°	-0.4°	250	170	70	30	35	20
0.2°	+30°	95	64	26	11	13	7.6
0.5°	-0.4°	200	136	56	24	28	18
0.5°	+30°	60	40	17	7.2	8.4	4.8

Type VII Micro Prismatic Retroreflective Element Material

Obs. Angle	Entrance Angle	WHITE	YELLOW	ORANGE	GREEN	RED	BLUE
0.2°	-0.4°	750	560	280	75	150	34
0.2°	+30°	430	320	160	43	86	20
0.5°	-0.4°	240	180	90	24	48	11
0.5°	+30°	135	100	50	14	27	6.0

Type VIII Micro Prismatic Retroreflective Element Material

Obs. Angle	Entrance Angle	WHITE	YELLOW	ORANGE	GREEN	RED	BLUE	BROWN
0.2°	-0.4°	700	525	265	70	105	42	21
0.2°	+30°	325	245	120	33	49	20	10
0.5°	-0.4°	250	190	94	25	38	15	7.5
0.5°	+30°	115	86	43	12	17	7	3.5

Type IX Micro Prismatic Retroreflective Element Material

Obs. Angle	Entrance Angle	WHITE	YELLOW	ORANGE	GREEN	RED	BLUE
0.2°	-0.4°	380	285	145	38	76	17
0.2°	+30°	215	162	82	22	43	10
0.5°	-0.4°	240	180	90	24	48	11
0.5°	+30°	135	100	50	14	27	6.0
1.0	-0.4°	80	60	30	8.0	16	3.6
1.0	+30°	45	34	17	4.5	9.0	2.0

Type X Micro Prismatic Retroreflective Element Material

Obs. Angle	Entrance Angle	FLUORESCENT ORANGE
0.2°	-0.4°	200
0.2°	+30°	90
0.5°	-0.4°	70
0.5°	+30°	26

The wet performance measurements on unweathered sheeting shall be conducted in accordance with one of the following methods:

1. The standard rainfall test specified in Federal Specification LS 300C and the brightness of the reflective sheeting totally wet by rain shall not be less than 90 percent of the above values.
2. Samples shall be submerged in a tank of clean water (approximately 72°F) for a period of 5 minutes. Reflex-reflective performance of the sheeting shall be viewed in a darkened room by reflected light through the surface of the water or through a transparent plane surface of the tank parallel to the sample surface. Light source shall be such as a hand flashlight held close to the eye. The wet sheeting shall show no apparent loss of reflective performance as compared to dry material.

The sheeting shall conform to the applicable daytime color and luminance factor requirements of ASTM D 4956 when tested instrumentally in accordance with Section 8.4 of that Specification; OR, the diffuse day color of the reflective sheeting shall be visually evaluated by comparison with the applicable Highway Color Tolerance Chart. Color comparison shall be made under north daylight or a scientific daylight having a color temperature from 6500 degrees to 7500 degrees Kelvin. Daytime color evaluation shall be illuminated at 45 degrees and viewed at 90 degrees. There shall be no significant color shift when viewed under nighttime (retroreflective) conditions.

The reflective sheeting shall have a pre-coated pressure sensitive adhesive (Class 1) or a heat-activated adhesive (Class 2) either of which will adhere to flat, clean surfaces without necessity of additional adhesive coats on the reflective sheeting or application surface. Chemical activators shall not be used to activate Class 2 adhesive. The pre-coated adhesive shall be protected by an easily removed liner which, when removed, shall not have a staining effect on the reflective sheeting and shall be mildew resistant. The protective liner attached to the adhesive shall be removable by peeling without soaking in water or other solvents and shall be easily removed after storage for 4 hours at 150°F under weight of 215-psi. The sheeting with liner removed, conditioned for 24 hours at 72°F and 50 percent relative humidity, shall be sufficiently flexible to show no cracking when bent around a 1.2-inch diameter mandrel with the adhesive side contacting the mandrel. For ease of testing, talcum powder may be spread on the adhesive to prevent sticking to the mandrel. The sheeting surface shall be smooth and flat to facilitate self-cleaning in the rain, regular cleaning, and wet performance, and exhibit 85 degrees glossmeter rating of not less than 50 when tested in accordance with ASTM D 523. The sheeting surface shall be readily processed and compatible with transparent and opaque process colors and show no loss of the color coat with normal handling, cutting, and application. The sheeting shall permit cutting and color processing at temperatures of 60°F to 100°F and 20 to 80 percent RH. The sheeting shall be heat resistant and permit force curing without staining of unapplied sheeting or applied sheeting at temperatures recommended by the manufacturer not to exceed 150°F for unapplied sheeting or 200°F for applied sheeting. The sheeting surface shall be solvent resistant to permit cleaning by wiping with a clean soft cloth dampened with VM&P Naphtha or mineral spirits.

The adhesive shall form a durable bond to smooth, corrosion and weather resistant surfaces and permit the reflective sheeting to adhere securely, 48 hours after application at temperatures of -30°F to 200°F. The adhesive bond shall be sufficient to render the applied sheeting vandal-resistant and prevent its shocking off when subjected to an impact energy of 20 ft. lbs. applied with a hemispherical tipped object 1-inch in diameter at -0°F. The test specimen shall be applied to aluminum backing not less than 0.080-inch thick and having a dimension of not less than 4-inches square. During testing, the specimen shall be supported on a 3-inch diameter ring.

The adhesion test shall conform to ASTM D 4956 with the addition of the temperatures noted above.

The resistance to accelerated weathering shall be as described in ASTM D 4956 except the weathering apparatus and procedure shall be in accordance with ASTM G 154.

The reflective sheeting shall be sufficiently flexible to be cut to shape easily and permit application over, and conform to, moderate shallow embossing characteristic of certain sign borders and symbols. The tensile strength of the sheeting shall be 5 to 20 pounds per square inch width when conditioned for 48 hours in accordance to ASTM D 685 and tested in accordance with ASTM D 828. Following liner removal, the reflective sheeting shall not shrink more than $\frac{1}{32}$ -inch in ten minutes nor more than $\frac{1}{8}$ -inch in 24 hours in any dimension per 9-inch square at 72°F and 50 percent relative humidity.

The sheeting, when applied according to manufacturer's recommendations to cleaned and etched 0.020-inch x 2-inch x 8-inch aluminum, conditioned (24 hours) and tested at 72°F and 50 percent relative humidity, shall be sufficiently flexible to show no cracking when bent around a $\frac{3}{4}$ -inch diameter mandrel.

9-28.12(1) Application

The reflective sheeting shall be applied in the manner specified by the sheeting manufacturer. The applied sign face shall not have bubbles, wrinkles, or foreign material beneath the reflective sheeting.

9-28.12(2) Edge Treatment

All edges and splices of reflective sheeting signs shall be coated with an edge sealer when recommended by the manufacturer of the reflectorized sheeting.

9-28.12(3) Splices and Color Matching

Splicing of reflective sheeting shall not be permitted on signs or panels with dimensions up to and including 48-inches in height or width unless the reflective sheeting specified does not come in this width, then the widest width material shall be used. When sheeting joints are required, they shall be lap-jointed with the top sheet overlapping the bottom sheet by no less than $\frac{3}{16}$ -inch. The fabricator shall endeavor to use the least number of seams possible with the horizontal lap preferable. Roller applied or reverse screened sheeting may be butt-jointed with joint gap not to exceed $\frac{1}{32}$ -inch. Color matching of adjacent sheets of reflective sheeting comprising a sign shall be accomplished without a noticeable difference in color. No borders shall be spliced other than the splice of the tangent border to the corner radius.

9-28.13 Demountable Prismatic Reflectorized Message and Borders

The letters, digits, and alphabet accessories shall consist of embossed 0.040-inch thick sheet aluminum frames conforming to ASTM B 209 grade 3003-H14 in which prismatic reflectors are installed to prevent their displacement in handling or service. Letters in which reflectors are assembled by means of tape are unacceptable. The plastic reflectors face shall be colorless and be entirely smooth to present a water repellent and dirt resistant surface. The area indicating the letter shape that is not reflectorized shall be white for maximum daytime contrast with the sign background. All letters shall be free of any imperfections and shall present a high quality appearance. Demountable prismatic border shall be comprised of a minimum length of 2-feet with allowance of one shorter section between each corner radius.

Letters shall be fastened to the sign with aluminum screws or blind rivets conforming to ASTM B 209 grade 2024-T4.

The coefficient of retroreflection of each reflex reflector intended for use in cutout letters, symbols, and accessories shall be equal to or exceed the following minimum values with measurements made with reflectors spinning.

Observation Angle (degrees)	Entrance Angle (degrees)	Coefficient of Retroreflection Candle Power/Square inch/ Foot Candle
0.1	0	14.0
0.1	20	5.6

Failure to meet the specific minimum values shall constitute failure of the reflector being used. Upon failure of more than two of the 50 samples tested, a resample of 100 reflectors shall be tested. Failure of more than four of these samples shall be cause for rejection of the lot.

9-28.14 Sign Support Structures

All sign support structures shall be constructed as shown in the Plans.

9-28.14(1) Timber Sign Posts

At the Contractor's options, timber sign posts and mileposts shall be treated Douglas Fir or treated Hem-Fir meeting the grades specified in Section 9-09.2. Douglas Fir and Hem-Fir posts shall be given a treatment in accordance with Section 9-09.3(1). Preservative and retention shall be as shown in Section 9-16.2 for sawn posts.

9-28.14(2) Steel Structures and Posts

Truss chords, struts, and diagonals, end posts, and end post struts and diagonals for sign bridge structures and cantilever sign structures shall conform to either ASTM A 36 or ASTM A 53 Grade B Type E or S. The nominal pipe diameter and the pipe wall thickness shall be as shown in the Plans or Standard Plans. All other structural steel for sign bridge structures and cantilever sign structures shall conform to either ASTM A 36 or ASTM A 992. Truss member connection hardware shall conform to Section 9-06.5(3).

Pipe members for bridge mounted sign brackets shall conform to ASTM A 53 Grade B Type E or S, and shall be Schedule 40 unless otherwise specified. All other structural steel for bridge mounted sign brackets shall conform to either ASTM A 36 or ASTM A 992. U bolts, and associated nuts and washers, shall be stainless steel conforming to Section 9-28.11, and shall be fabricated hot.

Anchor rods for sign bridge and cantilever sign structure foundations shall conform to ASTM F 1554 Grade 105, including Supplemental Requirements S2, S3, and S5. Nuts and washers for sign bridge and cantilever sign structure foundations shall conform to AASHTO M 291 Grade DH and AASHTO M 293, respectively.

Steel sign structures and posts shall be galvanized after fabrication in accordance with AASHTO M 111, unless noted otherwise in the Plans. All bolts, nuts, and washers shall be galvanized after fabrication in accordance with AASHTO M 232. Unless otherwise specified in the Plans or Special Provisions, metal surfaces shall not be painted.

Except as otherwise noted, steel used for sign structures and posts shall have a controlled silicon content of either 0.00 to 0.04 percent or 0.15 to 0.25 percent. If the Plans or Special Provisions specify painting of the galvanized steel surfaces, then the controlled silicon content requirement does not apply for those steel members. Mill test certificates verifying the silicon content of the steel shall be submitted to both the galvanizer and the Engineer prior to beginning galvanizing operations.

Minor fabricating and modifications necessary for galvanizing will be allowed if not detrimental to the end product as determined by the Engineer. If such modifications are contemplated, the Contractor shall submit to the Engineer, for approval, six copies of the proposed modifications, prior to fabrication.

9-28.14(3) Aluminum Structures

Welding of aluminum shall be in accordance with ANSI/AWS D1.2, latest edition, Structural Welding Code.

Aluminum materials shall conform to ASTM B 209 grades as follows: the filler alloy shall be 4043, 5365, or 5556 for welding base metals 6061 or 6063 to 6061, 6063, 356, or A356. Filler alloy for welding base metal 5086 shall be 5356 or 5556.

9-28.15 Vacant